

Guidelines for Procedures Utilizing Anesthesia and Analgesia in experimental animals

Purpose: These guidelines have been developed to provide minimum standards for experimental procedures involving **anesthesia and analgesia** in rodents, and assure that all LBNL procedures involving experimental animals are in compliance with Animal Welfare Regulations and follow standards described in the *Guide for Care and Use of Laboratory Animals*. It is the responsibility of the investigator to ensure use of techniques and procedures which result in the least pain and distress to the animal, while adequately addressing the needs of the experimental design. All procedures involving **procedures that may cause pain and distress** must be reviewed and approved by the AWRC prior to their implementation and **include anesthetic/analgesic administration dose, route, and frequency**. Exceptions to these guidelines are possible if justified for the experiment and reviewed and approved by the AWRC.

Training: It is the responsibility of the investigator to assure that all individuals performing unsupervised **anesthesia and analgesia** are adequately trained to do so. Competency for administration of anesthesia/analgesia for any surgical procedure by must be certified by the staff veterinarian.

The LBNL veterinarian recommends the following anesthetics/analgesics, routes and dose ranges for use in commonly used rodents. The veterinarian is available for consultation on these and other anesthetics and anesthetic protocols. All drugs, doses and routes of administration must be stated in the investigator's approved Animal Use Protocol (AUP).

1. **Inhaled anesthetics:** Isoflurane delivered by mask or endotracheal tube via a precision vaporizer is recommended for all species. Vaporizers are available for use in all facilities. Isoflurane anesthesia delivered via an open drop system may be appropriate for specified procedures by well-trained individuals, but must be performed in a fume hood.
2. **Injectable anesthetics:** Injectable anesthetics are appropriate for many procedures. There is, however, a great deal of variation in depth and duration of anesthesia among rodent strains and individual animals.

Anesthetics:

| Drug | Mouse | Rat |
|------------------------------------|---|---|
| Pentobarbital ¹ | 40-85 mg/kg IP | 40-50 mg/kg IP |
| Ketamine/ Xylazine ² | 90-120 mg/kg 5-10 mg/kg SQ or IP (not IM) (May not provide surgical anesthesia in mice. Consult with an OLAC veterinarian before using this mixture in mice.) | 90 mg/kg 10 mg/kg SQ or IP (not IM) |

¹ Not recommended for survival surgery.

² Xylazine is a potent respiratory depressant. Re-dosing, if necessary, should be done with 1/2 the original dose of Ketamine alone.

Analgesics:

| Drug | Mouse | Rat |
|-----------------------------------|---------------------------------------|-----------------------------------|
| Buprenorphine | 0.05-0.1 mg/kg SQ every 8-12 hours | 0.05 mg/kg SQ every 8-12 hours |
| Flunixin meglumine (Banamine®) | 2.5 mg/kg SQ every 12 hours | 1-2.5 mg/kg SQ every 12 hours |
| Meloxicam (Metacam®) | 10 mg/kg SC or PO once daily | 1-2 mg/kg SC or PO once daily |

General Injection Guidelines

1. **INJECTION SITES, VOLUMES AND NEEDLE SIZES** for purposes are presented for Mice in Table 2, and Rats in Table 3 below. The use of intradermal injection in mice and rats is not recommended, must be included in the AUP and anesthesia must be used. Always use the smallest volume possible. Table 3 & 4 below includes the maximum recommended volumes for commonly used injection sites of mice and rats.

Table 3. Recommended sites, needle sizes and maximum injection volumes for **mice** (25 g)

| | IV | IP | IM | SQ | PO |
|-------------|--------------------|-------------------|-----|------------------|--------------------------|
| Site | Lateral tail vein | Lower quadrant | NR* | Scruff, back | |
| Volume | 0.2 ml (8 µl/g) | 2 ml (80 µl/g) | | 1 ml (40µl/g) | 0.25 ml (10 µl/g) |
| Needle Size | ≤ 25 g. | ≤ 21 g. | | ≤ 20 g. | 22-24 g gavage needle |

*Not Recommended. The use in IM injection in mice must be reviewed approved in the AUP

Table 4. Recommended sites, needle sizes and maximum injection volumes for **rats** (250 g)

| | IV | IP | IM | SQ | PO (gavage) |
|-------------|--------------------|-------------------|----------------------|------------------|--------------------------|
| Site | Lateral tail vein | Lower abdomen | quadriceps | Scruff, back | |
| Volume | 0.5 ml (2 µl/g) | 5 ml (20 µl/g) | 1.1 ml (0.4 µl/g) | 5 ml (20µl/g] | 2.5 ml (10 µl/g) |
| Needle Size | ≤ 23 g. | ≤ 21 g. | ≤ 23 g | ≤ 21 g. | 18-20 g gavage needle |